BERTAN High Voltage

INSTRUCTION MANUAL

INSTALLATION
and
OPERATING
INSTRUCTION MANUAL

SERIES
225 and 226

WARNING

THIS UNIT PRODUCES HAZARDOUS VOLTAGES. DO NOT APPLY INPUT POWER UNLESS ADEQUATE GROUNDING IS PROVIDED TO THE POWER SUPPLY AND THE HIGH VOLTAGE OUTPUT HAS BEEN PROPERLY CONNECTED.

WARRANTY

BERTAN Associates, Inc. warrants this instrument to be free from defects in material and workmanship for a period of one year from the date of shipment. This warranty does not apply to equipment that has been subjected to misuse or which has been repaired or altered in any way by the user. BERTAN Associates, Inc. is responsible only for the cost of materials and labor to repair or replace, FOB our factory, products proved to be defective during the warranty period. We are not liable for consequential damages incurred due to failure of this equipment. No other warranty is expressed or implied. All products returned under warranty must be shipped prepaid to the factory with documentation describing the malfunction noted. It is recommended that the factory be notified and a Return Authorization Number obtained prior to shipment. The equipment will be evaluated, then repaired or replaced and promptly returned if the warranty claims are found to be substantiated. A nominal service charge will be made for any unsubstantiated claims. Include the BERTAN Associates Model and Serial number in all correspondence with the factory.

THE DATA CONTAINED IN THIS MANUAL IS SUBJECT TO CHANGE WITHOUT NOTICE. WRITTEN PERMISSION FROM BERTAN ASSOCIATES, INC IS REQUIRED PRIOR TO THE REPRODUCTION OF ANY TECHNICAL DATA CONTAINED IN THIS MANUAL.
IM:0003

BERTAN ASSOCIATES, Inc. 121 New South Rd., Hicksville, NY 11801 • (516) 433-3110 • TWX 510-221-2144

SECTION I INTRODUCTION/SPECIFICATIONS

1.0 SCOPE OF MANUAL

This manual is provided to assist the user in the installation and operation of the Bertan Series 225/226 IEEE-488 programmable high voltage power supplies. Statements will apply to all models in both of the Series unless reference is made to specific models. For the protection of personnel and equipment, it is essential that this manual be thoroughly read prior to the installation and application of power.

1.1 PURPOSE OF EQUIPMENT

The series 225/226 is a family of regulated precision laboratory IEEE-488 programmable high voltage power supplies. They provide exceptional performance in critical applications such as nuclear and electro-optical instrumentation, precision CRT, medical imaging and capillary zone electrophoresis.

1.2 DESCRIPTION

The units are fully enclosed and designed to mount in a standard 19" rack. A wide range of stable output voltages, up to 30kV are available. The output voltage is controlled by the digital front panel controls or through an IEEE-488 interface which provides intelligent programming, monitoring and automatic overload protection of the power supply. Remote analog voltage or resistance programming is also available to the user as a standard feature as well as analog monitoring on either Model 225 or 226.

Output polarity reversal is achieved by a polarity switch on the rear panel of 1kV, 3kV and 5kV units. The 10kV and higher output models utilize an internal polarity reversing assembly.

The Series 225/226 units consist of a DC power supply which converts the AC line power to a low DC voltage and a DC to DC converter which generates the high DC voltage. Low voltage electronic solid state circuits and the microprocessor logic circuitry are mounted on plug-in printed circuit boards. The high voltage assembly is fully encapsulated in silicone rubber for reliable, arc-free, stable operation.

1.3 ELECTRICAL SPECIFICATIONS

Input Power:	115/230Vac $\pm$10%, 50 - 400Hz, 1.0A/0.5A
Output Power:	See TABLE 1.1 for Output Voltage & Output Current ratings for each model in the 225/226 Series.
Ripple:	See TABLE 1.1 for peak-to-peak ripple measured at maximum output.
Accuracy:	$\pm$(0.1% of setting + 0.05% of maximum kV)
Voltage Resolution:	Values given in TABLE 1.1 apply to Output Setting, Limit Setting and Monitor Output.
Current Resolution:	Values given in TABLE 1.1 apply to Limit Setting and Monitor Output.
Line Regulation:	$\pm$0.001% for a $\pm$10% input line change.
Load Regulation:	$\pm$0.005% for a NL to FL, FL to NL change.

TABLE 1.1

MODEL	OUTPUT VOLTAGE	OUTPUT CURRENT	RIPPLE	RESOLUTION VOLTAGE	RESOLUTION CURRENT
225-01R/226-01R	0 to 1kV	0 to 30mA	10mV	100mV	1μA
225-03R/226-03R	0 to 3kV	0 to 10mA	30mV	100mV	1μA
225-05R/226-05R	0 to 5kV	0 to 5.0mA	50mV	100mV	100nA
225-10R/226-10R	0 to 10kV	0 to 2.5mA	100mV	1V	100nA
225-20R/226-20R	0 to 20kV	0 to 1.0mA	500mV	1V	100nA
225-30R/226-30R	0 to 30kV	0 to 0.5mA	1.5V	1V	10nA

Stability: 0.01%/hr. ; 0.02%/8hrs.

Temp. Coeff: 50ppm per °C, over the range 0 to 50°C.

Protection: Short circuit and arc protected. Programmable voltage and current limits from 0% to 101% of maximum ratings.

Meter: 5 digit LED panel meter with polarity indicator.

Indicators: Front panel LED indicators for Power ON, High Voltage ON, Volts, Milliamps, Overload, Tripped. Including the following IEEE-488 OPERATION INDICATORS Remote, Listen, Talk, Service Request.

Digital Programming: Output Voltage, Output Voltage Limit, Output Current Limit, Overload Response Mode and Service Request Mode are all parameters which are programmable through the IEEE-488 interface.

Digital Monitoring: Output Voltage, Output Current, Mode Settings, Model Number and Software Revision are all parameters which can be monitored through the IEEE-488 interface.

Analog Programming: 0 to +5Vdc corresponds to 0 to maximum output voltage via rear panel PROGRAMMING/MONITOR connector. Programming may also be accomplished using a 5kΩ to 20kΩ low temperature coefficient wirewound or cermet type potentiometer.

Analog Monitoring: Remote current and voltage monitoring signals 0 to +5Vdc (via 10kΩ)are available at the rear panel PROGRAMMING/MONITOR connector. (See section 5.2 and Figure 5.1 for pin designations).

Polarity: Selectable by user. High voltage must be off and the output COMPLETELY DISCHARGED before switching.

Logic: $\overline{\text{TRIP}}$ input and polarity indication of the output voltage (NEG / POS).

Input Connector: IEC socket with detachable line cord. Line cord is provided.

Analog Connector: Amp 207456-4, the mating connector is provided with each unit. The REMOTE ANALOG connector pin designations can be found in Figure 5.1

Digital Connector: IEEE-488, (mating IEEE-488 cable is not provided).

HV Connector: The high voltage panel connector and its respective mating connector for all models in the 225/226 Series is listed in Table 1.2 below, all units are supplied with the appropriate mating high voltage connector.

TABLE 1.2

MODEL	HV OUTPUT CONNECTOR	MATING HV CONNECTOR
225-01R / 226-01R	JDK	PDB
225-03R / 226-03R	JDK	PDB
225-05R / 226-05R	JDK	PDB
225-10R / 226-10R	JJA	PJA
225-20R / 226-20R	JJA	PJA
225-30R / 226-30R	JJA	PJA

Size: 19" wide x 3-1/2" high x 9-5/8" deep
(483 x 89 x 244mm)

Weight: 15 lbs (6.8 kg)

SECTION II GENERAL DESCRIPTION

CAUTION- THIS UNIT CAN STORE HAZARDOUS VOLTAGE. COMPLETELY DISCHARGE HIGH VOLTAGE AT REAR PANEL GROUND TERMINAL BEFORE ATTEMPTING REMOVAL OF THE HIGH VOLTAGE CABLE.

2.1 INSTALLATION

The Series 225/226 high voltage power supplies mount in a standard 19" rack.

2.2 INPUT POWER

Input AC line voltage required is 115/230Vac ±10%, 50 - 400Hz, single phase. The LINE VOLTAGE selector switch on the rear panel selects either 115Vac or 230Vac operation.

2.3 POWER-ON/SELF TEST

When AC power is first applied the Series 225 will illuminate all of the LED segements in the front panel display for user inspection. Then the 225 will display its configuration as shown in the EXAMPLE 2.1 below.

DISPLAY EXAMPLE 2.1

'+225.01'	225-01R set to positive output polarity
'-225.01'	225-01R set to negative output polarity
'+225.30'	225-30R set to positive output polarity
'-225.30'	225-30R set to negative output polarity

While the above is being displayed the Series 225/226 performs a series of power-on self tests. If the internal self check detects a failure, the failure will be displayed as one of the following error messages:

E r r 1	µP RAM error
E r r 2	µP ROM error
E r r 3	µP A/D error

If no error is found the 225 will commence displaying voltage readings. Error messages for the 226 Series can be recieved via the GPIB, (see Section 3.2.2).

2.4 VOLTAGE CONTROL

The Series 225/226 power supply has three modes of controlling the high voltage output available to the user. Set the PROGRAM CONTROL switch (S101) on the rear panel to LOCAL/IEEE-488 if front panel control or remote IEEE-488 control is desired. If remote analog control is required set the switch to the REMOTE ANALOG position. The high voltage output can be remotely programmed from either an external voltage source or with an external potentiometer. When in the REMOTE ANALOG position the front panel controls have no effect on the output voltage.

At all times, regardless of the position of the rear panel PROGRAM CONTROL switch and status of the GPIB (Local, Remote or Local Lockout), the user may enable or disable the high voltage output by switching the HV ENABLE switch on the front panel. In addition, the voltage and current monitors are always active. Even when the PROGRAM CONTROL switch is set to REMOTE ANALOG control position or the GPIB has brought the unit to remote or local lockout; the front panel, GPIB and remote analog monitors may make voltage and current readings.

2.5 POLARITY REVERSAL

The front panel LED display will indicate which polarity the unit is set for. The display illuminates as soon as the line power is applied even if there is no high voltage output.

CAUTION- LINE INPUT POWER MUST BE TURNED OFF AND THE HIGH VOLTAGE SHOULD BE DISCHARGED FULLY BEFORE PROCEEDING TO REVERSE THE POLARITY.

2.5.1 POLARITY REVERSAL 1kV to 5kV OUTPUT MODELS

The screwdriver operated POLARITY SELECTOR switch (S3) is accessible at the rear panel of the instrument.

2.5.2 POLARITY REVERSAL 10kV to 30kV OUTPUT MODELS

The polarity is reversible by means of an internal switching module which is easily accessible upon removal of the top cover.

The polarity is reversed by rotating the polarity module 180° and then re-inserting it. An interlock automatically assures that the high voltage cannot be turned on until this module is installed in either position.

A remote polarity indication is provided at J107 (PROGRAMMING/MONITOR) connector jack located on the rear of the unit, (see section 5.3).

SECTION III GPIB OPERATION

CAUTION- THIS UNIT CAN STORE HAZARDOUS VOLTAGE. COMPLETELY DISCHARGE HIGH VOLTAGE AT REAR PANEL GROUND TERMINAL BEFORE ATTEMPTING REMOVAL OF THE HIGH VOLTAGE CABLE.

3.1 PROGRAM CONTROL SWITCH

Before the Series 225/226 may be used in a GPIB system, the power supply must be configured by setting the power supply's rear panel PROGRAM CONTROL switch (S101) in the LOCAL/IEEE-488 position.

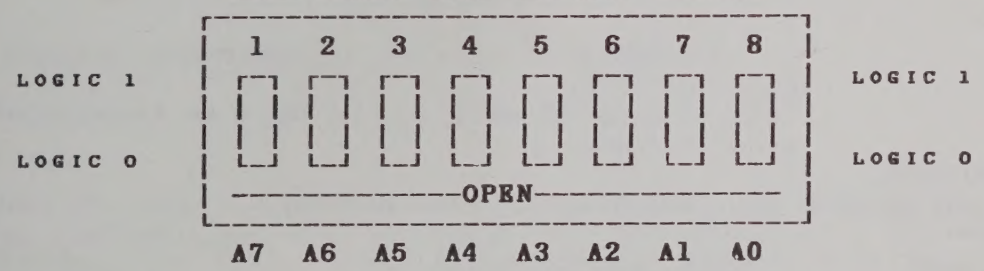
3.2 GPIB ADDRESS SWITCH

Located on the rear panel of the 225/226 is an eight position DIP switch (S9). Every instrument on a GPIB must have an unique bus address in the range 0 to 30, inclusive. The address is set with the five switches A4 through A0, A4 the most significant bit and A0 the least significant bit. Bit A5 of the address switch will enable or disable the power-on Service Request. Bit A6 controls whether the 225/226 will terminate character strings with or without a carriage return and a linefeed. Bit A7 must remain in the logic zero state. Figure 3.1 shows the switch orientation and bit designations.

The GPIB address switch is only read on power-on. Therefore, when the address is to be changed, the unit must be turned off and then back on.

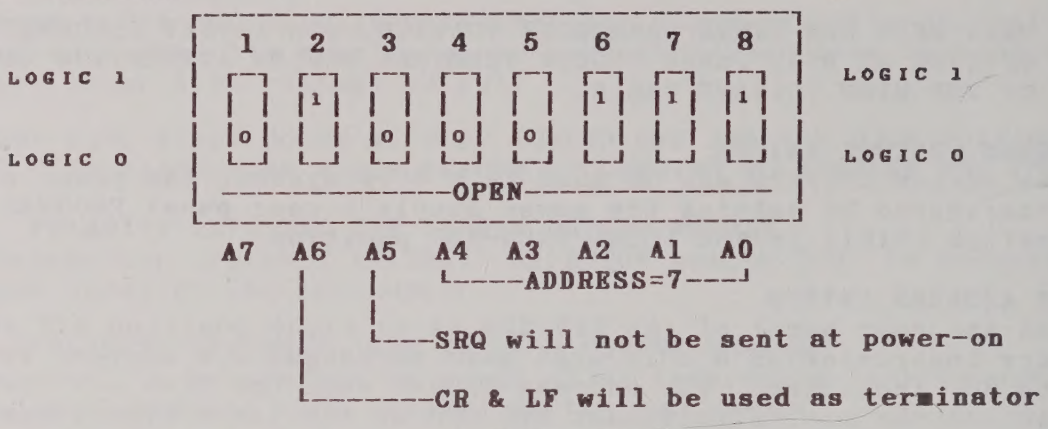
FIGURE 3.1

REAR PANEL GPIB ADDRESS SWITCH

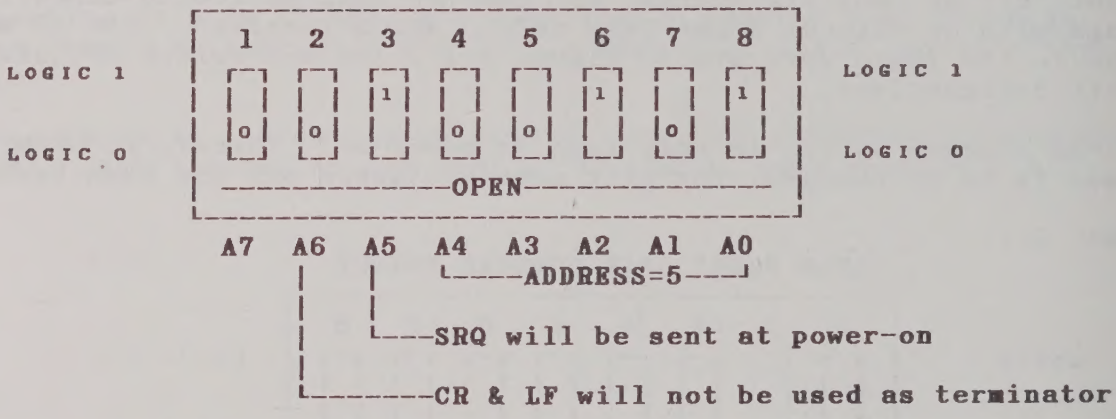


A7	Set to 0		
A6	Line Terminator:	1	Carriage Return & Linefeed
		0	No Character Terminator
A5	Service Request:	1	Service Request sent at power-on
		0	No Service Request is sent
A4	GPIB Address MSB		
A3	GPIB Address Bit		
A2	GPIB Address Bit		
A1	GPIB Address Bit		
A0	GPIB Address LSB		

FACTORY SETTING:



ALTERNATIVE EXAMPLE:



3.3 GPIB PROTOCOL

The 225/226 implements the following GPIB functions:

SH1	Source Handshake
AH1	Acceptor Handshake
T5	Basic Talker & Serial Poll
L4	Basic Listener
SR1	Service Request
DC1	Device Clear
DT1	Device Trigger
RL1	Remote/Local with Lockout
PP0	No Parallel Poll Response
C0	Not a Controller

Using these GPIB functions, the GPIB controller may send ASCII command strings to control and monitor the high voltage power supply.

3.3.1 DATA TRANSFER FUNCTIONS - SH1, AH1, T5, L4, RL1, PP0, C0

SH1, AH1, T5, L4, RL1, PP0 and C0 are data transfer functions, and normally transparent to the User. These functions permit the communication between the GPIB controller and the Series 225/226 high voltage power supply.

3.3.2 SERVICE REQUEST FUNCTIONS - SR1

SR1 contains two sub-functions; Service Request and Serial Poll. The service request is the mechanism by which the 225/226 may interrupt the GPIB controller and the serial poll is how the GPIB controller may read the status of the 225/226.

3.3.2.1 SERVICE REQUEST

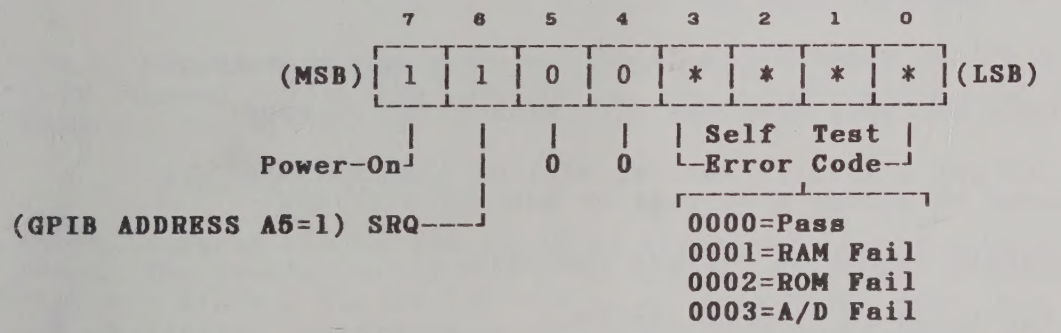
There are two conditions that will cause the 225/226 to generate a service request; at power-on and during user programmed overload detection. The meaning of the serial poll status byte that is read depends on the condition that caused the service request. The power-on mode is true when the 225/226 is first turned on and before the GPIB controller sends a command to the interface. The overload detect mode is after the GPIB controller has sent its first command to the interface. Any service request may be ignored without affecting operation of the interface or power supply.

3.3.2.2 SERIAL POLL

When the GPIB controller executes a serial poll, the 225/226 sends it one byte of status. As mentioned above, the decoding of the status byte is dependent on when it is read. The FIGURE 3.2 below shows the decoding of the power-on status byte, and FIGURE 3.3 shows the decoding of the 'normal operation' (not the power-on) status byte.

FIGURE 3.2

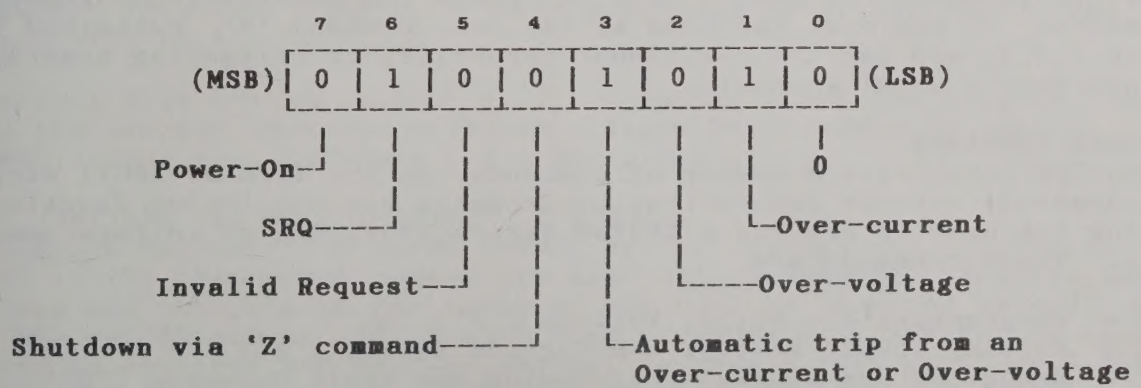
At power-on before any command is sent, the status byte is:



Note that the MSB is logic 1 which identifies this byte as the status register contents at power on, prior to the issuance of any command. If the user does not do a serial poll at power on and sends any command, the status byte obtained in response to a subsequent serial poll will appear as seen in FIGURE 3.3 below.

FIGURE 3.3

After first command the register looks like this:



Note that the MSB of this byte is logic 0 which identifies this byte as the status register contents following the issuance of at least one command since power on.

When the SRQ bit is logic 1, it means that this status byte is in response to the first serial poll following the issuance of an SRQ. If the SRQ bit is logic 0, it means that the status byte obtained is one you have previously examined and/or is not in response to a service request.

When the invalid request bit is logic 1, it means that you have issued a command the unit cannot recognize. Normally this bit stays at logic 0.

A logic 1 in any of the five remaining bits indicates a "true" state of that parameter. A logic 0 indicates a "false".

EXAMPLE BIT PATTERN:

7	6	5	4	3	2	1	0
0	1	0	0	1	0	1	0

BIT#:	MEANING:
7	0: You are looking at the status byte after at least one command.
6	1: You are making your first examination of this byte after the unit's issuance of an SRQ.
5	0: The previous command was valid.
4	0: You have not shut down the unit with a "Z" command.
3	1: You did get a trip (a turning off) of high voltage in response to either a voltage or current overload.
2	0: The supply is not in voltage overload.
1	1: The supply is in current overload.
0	0: This bit of this status byte is always logic 0.

3.3.3 DEVICE CLEAR FUNCTION - DC1

The device clear and selective device clear GPIB functions set the high voltage output to 0 volts regardless of the current voltage program. They perform identically to the user command 'Z' explained in section 3.4.4.

3.3.4 DEVICE TRIGGER FUNCTION - DT1

The device trigger function is used to update the previously programmed parameters. It performs the same as the user command 'G', explained in section 3.4.3, and has the additional capability of triggering numerous bus instruments simultaneously.

3.4 USER COMMANDS

The 225/226 recognizes a number of commands, in the form of ASCII strings These commands execute the various programming and monitoring functions enabling the user to control a BERTAN Series 225/226 high voltage power supply. These commands are:

- Programming the Output Voltage ('P')
- Setting Output Voltage and Current Limits ('L')
- Executing the Current Programming and Limit Commands ('G')
- Shutting Off the High Voltage Output ('Z')
- Restoring the High Voltage Output ('R')
- Selecting the Overload Shutdown Response ('OE' & 'OC')
- Selecting the Overload Service Request Response ('SE' & 'SC')
- Triggering Meter Readings of the Output ('T')
- Polarity, Model Number & Software Revision Information ('M')

NOTE: **All characters in the ASCII command string must be in UPPER CASE ONLY. The interface will not recognize lower case characters.**

The syntax of the commands is fairly rigid, especially the format of the numeric voltage and current strings. Table 3.0 shows the numeric formats for programming the Series 225/226 high voltage power supply.

TABLE 3.0

NUMERIC FORMATS FOR PROGRAM, LIMIT & METER COMMANDS:

MODEL	FORMAT VOLTAGE	FORMAT CURRENT
225/226-01	x.xxxx	xx.xxx
225/226-03	x.xxxx	xx.xxx
225/226-05	x.xxxx	x.xxxx
225/226-10	xx.xxx	x.xxxx
225/226-20	xx.xxx	x.xxxx
225/226-30	xx.xxx	xxx.xx

3.4.1 PROGRAMMING THE HIGH VOLTAGE OUTPUT ('P')

This command allows the user to set the output voltage of the power supply. The syntax is:

'P{numeric string}K'

Where {numeric string} is an ASCII string of five digits with a decimal point. The resolution of the programming value (and monitors) is five digits. Since a Series 225/226 power supply may each have a different output rating, the programming command will have different formats. In general, the program command will be one of those shown below:

Px.xxxxK
Pxx.xxxK

The numeric format (x.xxxx or xx.xxx) will depend on the unit being controlled. This numeric format must be packed with zeroes to fully fill five digits and decimal point. Therefore, if a 1kV power supply, with format x.xxxx is to be programmed to 230 volts, the command will be P0.2300K. If a 20kV supply is to be programed to 11,500 volts, the command will be P11.500K.

The actual high voltage output will not change after the program command until the 225/226 receives a device trigger bus command or the 'G' command string (see sections 3.3.4 and 3.4.3).

3.4.2 SETTING THE OUTPUT LIMITS ('L')

The 225/226 monitors the power supply output voltage and current to detect if the parameters exceed the user set thresholds. Each parameter (voltage and current) is monitored at the rate of once per second. The user may set threshold limits that when exceeded will invoke the user programmed shutdown and service request responses (see sections 3.4.6 and 3.4.7). The limit commands start with an 'L' followed by a numeric string that represents the threshold value, then followed by a character that distinguishes between the voltage and current limits. A 'K' indicates a kilovolt limit and an 'M' or 'U' indicates a milliamp or microamp limit respectively. The syntax is:

'L{numeric string}K' Kilovolt Limit
'L{numeric string}M' Milliamp Limit, or
'L{numeric string}U' Microamp Limit (Model 225/226-30R only)

where {numeric string} is as described Table 3.0. It is very likely that the numeric formats for the voltage and current will be different.

The voltage limit command uses the same numerical format as the programming command, but starts will an 'L'. Below are some examples:

Lx.xxxxK L0.6523K limits to 652.3V
Lxx.xxxK L29.400K limits to 29.4kV

The output current limit threshold may also be set. When this value is exceeded the 225/226 will respond as programmed by the user. This command also requires a strict numerical format. Since it represents output current, the decimal point may be in a different position than the voltage format. Below are some examples of the current limit command.

Lxx.xxxM L12.000M limits to 12mA
Lx.xxxxM L1.0500M limits to 1.05mA
Lxxx.xxU L473.50U limits to 473.5uA (Model 225/226-30R only)

The actual limit values will not change after the limit command until the 225/226 receives a device trigger bus command or the 'G' command string (see sections 3.3.4 and 3.4.3).

3.4.3 ENTERING THE CURRENT PROGRAMMING & LIMIT VALUES ('G')

After executing a programming or limit command, these new values will not be used immediately. The user must execute the 'G' command that will update the current values with the new ones. Therefore, if the output is currently programmed to 1kV and the user executes a program command such as 'P1.5000K', the output will not change until the 'G' command is executed. The syntax is:

'G' the single ASCII character

When timing is not important, the 'G' may be appended to the programming or limiting command as shown below.

Pxx.xxxKG
Lx.xxxxMG

3.4.4 SHUTTING THE HIGH VOLTAGE OUTPUT OFF ('Z')

The high voltage output may be turned off by the user without affecting the programming value. The syntax is:

'Z' the single ASCII character

This is the same effect as executing the device clear bus command.

3.4.5 RESTORING THE HIGH VOLTAGE OUTPUT ('R')

The high voltage output may be turned back on to the currently active programming level after it was shut off by a user command 'Z' or a trip due to overload. The syntax is:

'R' the single ASCII character

The high voltage output will return to the value that was programmed before the shutdown. If the output is off because of an overload trip, the cause of the overload should be corrected before restoring the output voltage or the trip will occur again.

3.4.6 SELECTING THE OVERLOAD TRIP RESPONSE ('OE' & 'OC')

When the 225/226 detects that the power supply has exceeded one of the user programmed limits, it may respond by shutting off the high voltage output, also known as tripping. The user may select that the power supply be tripped for a voltage overload, a current overload, either a voltage or current overload, or neither. The syntax is:

'OE{numeric}'
'OC{numeric}'

where {numeric} is the ASCII byte for 0,1 or 2 and:

OE2 Enable the overvoltage control so that the output voltage cannot be programmed above the voltage limit setting.

OE1 Enable the overvoltage control to shut down the power supply upon detection of an output voltage above the voltage limit setting.

OE0 Disable the overvoltage control to prevent shutting down the power supply in response to the detection of an output voltage above the voltage limit setting.

OC1 Enable the overcurrent control to shut down the power supply upon detection of an output current above the current limit setting.

OC0 Disable the overcurrent control to prevent shutting down the power supply in response to the detection of an output current above the current limit setting.

3.4.7 SELECTING THE OVERLOAD SERVICE REQUEST RESPONSE ('SE' & 'SC')

Just as the 225/226 may be made to shut off the output during an overload, it may be made to generate a service request to the GPIB controller. The syntax is:

'SE{numeric}'
'SC{numeric}'

where {numeric} is the ASCII byte for 0 or 1 and:

SE1 Enable SRQ in response to an overvoltage detection.

SE0 Disable SRQ in response to an overvoltage detection.

SC1 Enable SRQ in response to an overcurrent detection.

SC0 Disable SRQ in response to an overcurrent detection.

When an SRQ is received, the user should execute a serial poll of the unit. The status byte will be the result of the serial poll. Please note that overload enabling/disabling and service request choices operate independently of each other.

3.4.8 TRIGGERING METER READINGS OF THE OUTPUT ('T')

The 225/226 has the capability to perform meter readings of the power supply output voltage and current. The user may trigger a reading of the output voltage, current or both. The syntax is:

'T{numeric}'

where {numeric} is the ASCII byte for 0,1 or 2 and:

T0 Triggers a measurement of the output voltage and current.

T1 Triggers a measurement of the output voltage only.

T2 Triggers a measurement of the output current only.

Since this is an ASCII string it may be printed directly to the CRT or printer. After receiving the 'T' command the 225/226 will return a character string containing the output status (Normal, Tripped or Shutdown) and the voltage and/or current readings in the same numerical format as is used to enter voltage and current values. Below are the 'T' commands with representative measurement strings that would be returned from the 225/226.

T0 'N Vxx.xxxK Ix.xxxxM'
T1 'N Vx.xxxxK'
T2 'N Ixxx.xxU'

Where the 'N' in the string means the output is on. It may be replaced with an 'S' that means the output was shutdown by user with an 'Z' command or device clear bus command, or a 'T' in that means the output was tripped due to an overload detection and:

'V' in the string means voltage
'I' in the string means current
'K' in the string means kilovolts
'M' in the string means milliamps
'U' in the string means microamps

3.4.9 STATUS ('M')

The 225/226 can respond with a string that tells the user the model number, output polarity setting and software revision number of the power supply. The syntax is:

'M' the single ASCII character

Where the polarity, model number and software revision status is given on the next talk. Example: '+225 03 re0.3' denotes positive high voltage output from 0 to 3 kV and revision 0.3 software.

3.5 SAMPLE COMPUTER PROGRAMS

Sample computer programs for use with the Series 225/226 can be found in the APPENDIX of this manual. Each sample sends commands to the power supply and shows response via the computer's CRT.

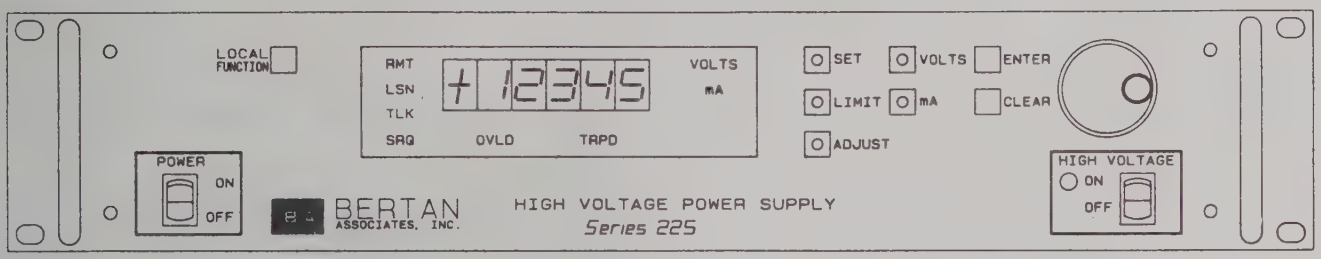
SECTION IV LOCAL OPERATION

CAUTION- THIS UNIT CAN STORE HAZARDOUS VOLTAGE. COMPLETELY DISCHARGE HIGH VOLTAGE AT REAR PANEL GROUND TERMINAL BEFORE ATTEMPTING REMOVAL OF THE HIGH VOLTAGE CABLE.

4.1 FRONT PANEL CONTROLS

This section applies only to the Series 225. The POWER ON/OFF switch, HIGH VOLTAGE ON/OFF switch, and the HIGH VOLTAGE ON LED are the only items also found on the Series 226 front panel. FIGURE 4.1 below is the typical layout of the Series 225 front panel.

FIGURE 4.1



SWITCHES/PUSHBUTTONS/INDICATORS/DIALS:	FUNCTION/PURPOSE:
POWER ON-OFF	Enables/Disables AC power
HIGH VOLTAGE ON-OFF	Enables/Disables high voltage. This front panel switch overrides all other programming signals to disable the high voltage output
LOCAL/FUNCTION	Brings unit from GPIB remote to front panel local control. When in local control it also allows access to programmable features as well model information
SET	Used to set output voltage
LIMIT	Used to program the output voltage limit and output current limit
ADJUST	Used to adjust the output voltage
VOLTS	Enables display to show the output voltage readings and is used when changing the output voltage or voltage limit
mA	Enables display to show the output current readings and is used when changing the output current limit
ENTER	Used to complete a command sequence

CLEAR	Used to abort a command sequence
DIGITAL POTENTIOMETER	Used for entering numerics or selecting modes. The action of this potentiometer is velocity dependent so that when it is rotated slowly, the resolution is very high and when it is rotated rapidly, the rate at which a value changes is large
LED DISPLAY	5 digit meter face for displaying voltage and current readings and mode settings
RMT	Remote/Local status of GPIB
LSN	Listener status of GPIB
TLK	Talker status of GPIB
SRQ	Service request status of GPIB
OVLD	Output overload indicator
TRPD	Output overload trip indicator
VOLTS	Illuminated when meter is displaying output volatge
mA	Illuminated when meter is displaying output current

4.2 PROGRAM CONTROL SWITCH

Before the front panel controls of the Series 225 may be used the power supply must be configured by setting the power supply's rear panel PROGRAM CONTROL switch (S101) in the LOCAL/IEEE-488 position.

4.3 LOCAL OPERATION

The local mode of the Series 225 provides all of the control and monitoring functions available with GPIB control. An SRQ may occur with no controller connected to the IEEE-488 connector port (J9). The SRQ front panel LED will illuminate and stay illuminated; this is of no concern when in the local mode. An unanswered SRQ will not affect local control in any way and the illuminated LED may be safely ignored.

A function of the GPIB may be to make the 225 only receive programming information from the GPIB. When the 225 is in remote (front panel RMT LED lit), in order to program the output high voltage, the user must press the LOCAL/FUNCTION pushbutton on the front panel. After the LOCAL pushbutton is depressed the front panel will display 'LLO', this means that the GPIB controller has locked out local control and only the controller may program the high voltage output. If the remote (RMT) LED is not illuminated then the unit is in local control.

With each subsequent depression of the LOCAL/FUNCTION pushbutton the following information will be displayed:

▸GPIB address that the user has selected for the Series 225/226

▸Model number and setting of output polarity (see DISPLAY EXAMPLE 2.1)

▸Overvoltage trip response setting ('OE')

▸Overcurrent trip response setting ('OC')

▸Overvoltage service request response ('SrE')

▸Overcurrent service request response ('SrC')

▸Software revision number

A final depression will return the display to voltage or current readings as before the first LOCAL/FUNCTION pushbutton depression.

4.3.1 SELECTING THE OVERVOLTAGE TRIP RESPONSE ('OE')

When the Series 225 detects that the power supply has exceeded the user programmed overvoltage limit, it may respond by shutting off the high voltage output, also known as tripping. The syntax is:

OE1 Enable the overvoltage control to shut down the power supply upon detection of an output voltage above the voltage limit setting.

OE0 Disable the overvoltage control to prevent shutting down the power supply in response to the detection of an output voltage above the voltage limit setting.

This parameter may be changed in the local mode by rotating the digital potentiometer on the front panel.

4.3.2 SELECTING THE OVERCURRENT TRIP RESPONSE ('OC')

When the Series 225 detects that the power supply has exceeded the user programmed overcurrent limit, it may respond by shutting off the high voltage output, also known as tripping. The syntax is:

OC1 Enable the overcurrent control to shut down the power supply upon detection of an output current above the current limit setting.

OC0 Disable the overcurrent control to prevent shutting down the power supply in response to the detection of an output current above the current limit setting.

This parameter may be changed in the local mode by rotating the digital potentiometer on the front panel.

4.3.3 SELECTING THE OVERVOLTAGE SERVICE REQUEST RESPONSE ('SrE')

Just as the Series 225 may be made to shut off the output during an overload, it may be made to generate a service request to the GPIB controller. The syntax is:

SrE1 Enable SRQ in response to an overvoltage detection.

SrE0 Disable SRQ in response to an overvoltage detection.

This parameter may be changed in the local mode by rotating the digital potentiometer on the front panel.

4.3.4 SELECTING THE OVERCURRENT SERVICE REQUEST RESPONSE ('SrC')

Just as the Series 225 may be made to shut off the output during an overload, it may be made to generate a service request to the GPIB controller. The syntax is:

SrC1 Enable SRQ in response to an overcurrent detection.

SrC0 Disable SRQ in response to an overcurrent detection.

This parameter may be changed in the local mode by rotating the digital potentiometer on the front panel.

4.4 FRONT PANEL MESSAGES

DISPLAY	MEANING
E r r	Error condition exists, (use CLEAR pushbutton to remove).
S E	SET pushbutton was depressed.
A d	ADJUST pushbutton was depressed.
L i	LIMIT pushbutton was depressed.
A d r n n	Where nn is IEEE-488 bus address.
L L O	Local lockout is on.

4.5 OPERATION EXAMPLES

The following section describes the valid sequences of local control command entry by way of examples. Failure to follow these sequences or failure to adhere to the restrictions specified for each operation may result in the error message ('E r r') to be displayed on the front panel. The following are some common examples of NON-VALID sequences resulting in an 'E r r' message display:

COMMAND ENTRY	REASON FOR ERROR MESSAGE
'ADJUST' 'mA'	Cannot adjust power supply output current.
'SET' 'mA'	Cannot set power supply output current.
'SET' 'ENTER'	No controlled parameter, kV or mA, was selected.
'LIMIT' 'ENTER'	No controlled parameter was selected.
'ADJUST' 'ENTER'	No controlled parameter was selected.
'ENTER'	No controlled parameter or select function was selected.

4.5.1 OUTPUT VOLTAGE SETTING

Push 'SET' button: 'SET' LED lights, 'SE' message is displayed.

Push 'VOLTS' button: 'VOLTS' LED lights, the last entered voltage setting value is displayed.

Turn the digital potentiometer knob for the desired output voltage. The actual high voltage output will NOT change until the following step.

Push 'ENTER' to output that voltage. The 'SET' and 'VOLTS' LED's will go off. If the High Voltage switch is on, the set voltage value will be outputted and kV measurements will be displayed.

4.5.2 OUTPUT VOLTAGE ADJUSTMENT

Push 'ADJUST' button: The 'ADJUST' LED lights and the 'Ad' message is displayed.

Push 'VOLTS' button: The 'VOLTS' LED lights and the output voltage is displayed.

Turn the digital potentiometer knob for the desired output voltage. **CAUTION**: The ACTUAL high voltage output will start changing immediately in response to this step.

Push 'ENTER' to finalize the adjustment and to exit the adjustment mode.

4.5.3 SETTING THE OUTPUT VOLTAGE LIMIT

Push 'LIMIT' button: The 'LIMIT' LED lights and the 'Li' message is displayed.

Push 'VOLTS' button: The 'VOLTS' LED lights and the present limit voltage is displayed.

Turn the digital potentiometer knob to set the new desired limit.

Push the 'ENTER' button to save the displayed entry as the new voltage limit value. The display then returns to presenting the previously measured parameter.

4.5.4 SETTING THE OUTPUT CURRENT LIMIT

Push 'LIMIT' button: The 'LIMIT' LED lights and the 'Li' message is displayed.

Push 'mA' button: The 'mA' LED lights and the present limit current is displayed.

Turn the digital potentiometer knob to set a new desired limit. Push the 'ENTER' button to save the displayed entry as the new current limit. The display then returns to presenting the previously measured parameter and the 'LIMIT' and 'mA' LED's go out.

SECTION V REMOTE ANALOG OPERATION

CAUTION- THIS UNIT CAN STORE HAZARDOUS VOLTAGE. COMPLETELY DISCHARGE HIGH VOLTAGE AT REAR PANEL GROUND TERMINAL BEFORE ATTEMPTING REMOVAL OF THE HIGH VOLTAGE CABLE.

5.1 PROGRAM CONTROL SWITCH

Before the Series 225 may be programmed with a remote analog (0 to +5Vdc) signal the power supply must be configured by setting the power supply's rear panel PROGRAM CONTROL switch (S101) in the REMOTE ANALOG position All other monitoring and functions are active, independent of the S102 position.

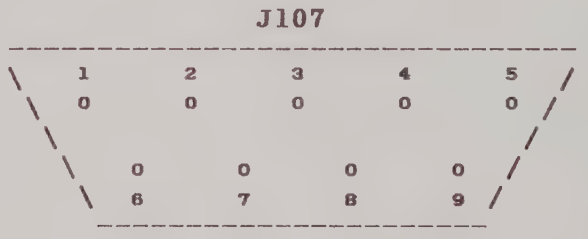
5.2 REMOTE CONTROL

The high voltage output can be remotely programmed from either an external voltage source or with an external potentiometer from the internal reference voltage source. A 0 to +5Vdc programming voltage applied to Pin 6 of J107 (PROGRAMMING/MONITOR) connector jack on the rear panel will remotely program the high voltage output from zero to maximum output. Programming can also be accomplished using a potentiometer connected between Pin 4 (+5Vdc), Pin 7 (GND) and with the wiper connected to Pin 6 (PRGM INPUT). The potentiometer should be a low temperature coefficient wirewound or cermet type, 5kΩ to 20kΩ resistance value. The output is proportional to the programming input.

5.3 ANALOG MONITORING SIGNALS

Analog monitor output voltage signals (0 to +5Vdc), linearly proportional to the power supply's output voltage and current are provided. A logic TRIP input signal, a +5Vdc reference output and a TTL polarity indicator output signal are also available at J107. FIGURE 5.1 below defines the pin locations and functions of the rear panel analog monitor and remote analog programming connector (J107).

FIGURE 5.1



PIN	FUNCTION
1	Buffered output voltage monitor 0 to +5Vdc via 10kΩ.
2	No connection
3	TTL level compatible logic input. Input logic zero disables high voltage generation. Open circuit or input logic one enables high voltage generation.
4	Precision +5Vdc reference output referenced to analog ground.
5	Buffered output current monitor 0 to +5Vdc via 10kΩ.
6	Remote analog programming input, 0 to +5 volts.
7	Analog ground.
8	Digital ground.
9	NPN open collector with respect to digital ground, indicating output high voltage polarity. NPN saturation denotes positive polarity (logic 0), NPN cut-off denotes negative polarity (logic 1).

SECTION VI MAINTENANCE

6.1 GENERAL

The high voltage power supply should not require any maintenance or calibration. It is designed for reliable, trouble free operation. If any question should arise, contact the Bertan Customer Service Department for assistance or return authorization. Although adequate information is provided in the schematic provided with this manual, it is suggested that the unit be returned to the factory if service should become necessary.

SECTION VII APPENDIX

7.1 IBM PC/XT/AT (DOS 3.1 OR HIGHER REQUIRED)

1. Equip the computer with the IO Tech Personal 488A interface.
2. Install software driver per the Personal 488A instructions.
3. Set the address switches on the Model 225 to 7
4. Run the BASIC interpreter which comes with the computer.
5. Enter the lines of the program below using the "return" key after each line.
6. Press RUN key (F2) after the total program has been entered. Enter a command when prompted. For example, if you enter "P0.1000KG", wait approximately two seconds and then enter "T1G", the resulting display is nominally "N V0.1000K".

```
PROGRAM                                          REMARKS
10 OPEN "\DEV\IEEEOUT" FOR OUTPUT AS #1          Set up output file
20 IOCTL#1,"BREAK"                               Clear buffers in
                                                 basic
30 PRINT#1,"RESET"                               Init the bus with
                                                 IFC
40 OPEN "\DEV\IEEEIN" FOR INPUT AS#2             Set up input file
                                                 to BASIC
50 PRINT#1,"REMOTE 07"                           Place the 225 in
                                                 remote
60 INPUT "COMMAND";A$
70 PRINT#1,"OUTPUT 07;";A$                       Address 225 to
                                                 listen and send the
                                                 send the string
80 INPUT "COMMAND",A$
90 PRINT#1,"OUTPUT 07;";A$
100 PRINT#1,"ENTER 07"                           Address 225 to talk
110 LINE INPUT#2,A$                              Input the bytes
120 PRINT A$                                     Display the reading
130 END
```

7.2 IBM PS/2 USING IO TECH INTERFACE (DOS 3.1 OR HIGHER REQUIRED)

1. Equip the computer with the IO Tech PS/2 488A interface.
2. Install the Software driver following the PS/2 488A manual instructions.
3. Set the address switches on the Model 225 to 7
4. Run the BASIC interpreter which comes with the computer.
5. Enter the lines of the program below using the "return" key after each line.
6. Press RUN key (F2) after the total program has been entered. Enter a command when prompted. For example, if you enter "P0.1000KG", wait approximately two seconds and then enter "T1G", the display should nominally return "N V0.1000K".

```
PROGRAM                                          REMARKS
10 OPEN "\DEV\IEEEOUT" FOR OUTPUT AS #1          Set up output file
20 IOCTL#1,"BREAK"                               Clear buffers in basic
30 PRINT#1,"RESET"                               Init the bus with IFC
40 OPEN "\DEV\IEEEIN" FOR INPUT AS#2             Set up input file to
                                                 BASIC
50 PRINT#1,"REMOTE 07"                           Place the 225 in remote
60 INPUT "COMMAND";A$
```

```
 70 PRINT#1,"OUTPUT 07;";A$          Address 225 to listen
                                     and send the string
 80 PRINT#1,"ENTER 07"               Address 225 to talk
 90 INPUT "COMMAND";A$
100 PRINT#1,"OUTPUT 07;";A$
110 LINE INPUT#2,A$                  Input the bytes
120 PRINT A$                         Display the reading
130 END
```

7.3 HP 85/86/87

1. Equip the computer with an HP 82937 GPIB interface and an I/O ROM.
2. Set the address switches on the Model 225 to 7.
3. Enter the lines in the program below. Use the END LINE key after each line.
4. Press the RUN Key when the total program is entered. Enter a command when prompted to do so. For example, if you enter "P0.1000KG", wait approximately two seconds and then enter "T1G", the CRT will nominally show the string "N V0.1000K".

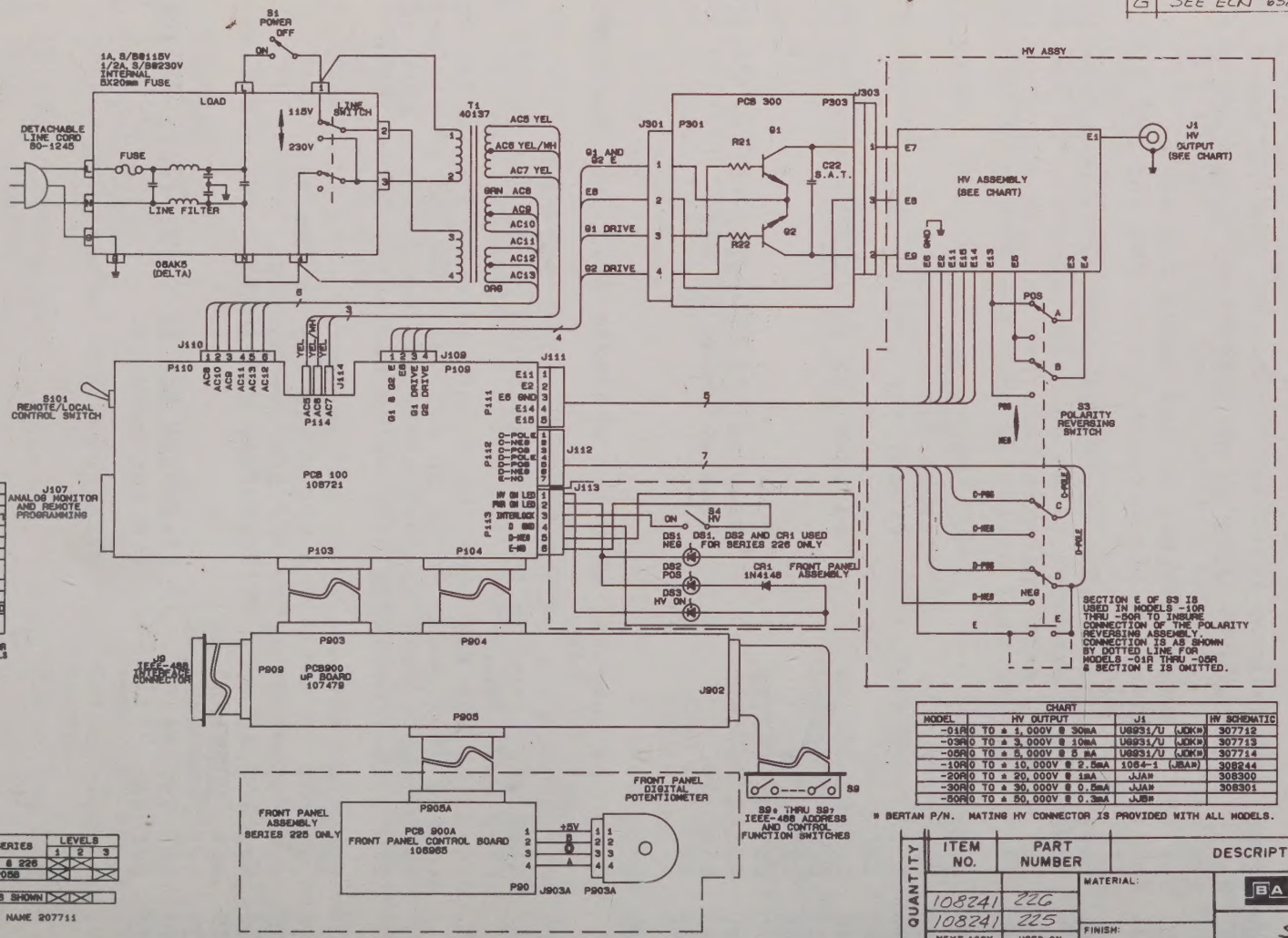
```
     PROGRAM                    REMARKS
 10  REMOTE 707                 Place 225 in remote.
 20  DISP "Command"             Prompt for command.
 30  INPUT A$
 40  OUTPUT 707;A$              Address 225 to listen, send string.
 50  DISP "Command"
 60  INPUT A$
 70  OUTPUT 707;A$
 80  ENTER 707;A$               Address 225 to talk, return reading.
 90  DISP A$                    Display ready on CRT.
100  END
```

7.4 HP 9825A

1. Equip the computer with the HP98034A GPIB interface and the extended I/O ROM.
2. Set the address switches on the Model 225 to 7.
3. Enter the lines in the program below using the "STORE" Key after each line.
4. Press the RUN Key when the total program is entered. Enter a command when prompted to do so. For example, if you enter "P0.1000KG", wait approximately two seconds and then enter "T1G", the resulting display is nominally "N V0.1000K".

```
     PROGRAM                    REMARKS
 10  rem 707                    Place the 225 in remote.
 20  ent "COMMAND",A$           Prompt for command.
 30  wrt 707,A$                 Address 225 to listen, send command.
 40  ent "COMMAND",A$
 50  wrt "COMMAND",A$
 60  red 707,A$                 Address 225 to talk, input reading.
 70  prt A$                     Print reading.
```

LTR	REVISIONS	DATE	APPROVED
G	SEE ECN 6586	5/14/90	JH



J107	
PIN	FUNCTION
1	kV MONITOR OUT
2	N.C.
3	TRIP
4	5V REF OUT
5	CURRENT MONITOR
6	Vo PROGRAM IN
7	ANALOG GROUND
8	DIGITAL GROUND
9	POLARITY IND (NEG/POS)

MATING ANALOG CONNECTOR IS PROVIDED WITH ALL MODELS

CHART			
MODEL	HV OUTPUT	J1	HV SCHEMATIC
-01A	0 TO ± 1,000V @ 30mA	U693I/U (JDK*)	307712
-03A	0 TO ± 3,000V @ 10mA	U693I/U (JDK*)	307713
-05A	0 TO ± 5,000V @ 5 mA	U693I/U (JDK*)	307714
-10A	0 TO ± 10,000V @ 2.5mA	1064-1 (JBA*)	308244
-20A	0 TO ± 20,000V @ 1mA	JJA*	308300
-30A	0 TO ± 30,000V @ 0.5mA	JJA*	308301
-50A	0 TO ± 50,000V @ 0.3mA	JJB*	

* BERTAN P/N. MATING HV CONNECTOR IS PROVIDED WITH ALL MODELS.

SERIES	LEVELS 1	2	3
225 & 226	X	X	
205B	X		X
LEVELS SHOWN	X	X	X

FILE NAME 207711

QUANTITY	ITEM NO.	PART NUMBER	DESCRIPTION	COMP DESIG
108241	226			
108241	225			
NEXT ASSY	USED ON			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON FRACTIONS·DECIMALS ANGLES

MATERIAL:

FINISH:

DR CB 5/10/88

CK

APVD HSB

BERTAN ASSOCIATES, INC
HICKSVILLE, NEW YORK

SCHEMATIC BLOCK DIAGRAM

SIZE	CODE IDENT NO	DRAWING NO
B	50429	207711

SCALE —

SHEET 1 OF 1